PLANT ITEM MATERIAL SELECTION DATA SHEET

R10591355

UFP-BRKPT-00001A/B (PTF)
Ultrafiltration Recycle Breakpot

- Design Temperature (°F)(max/min): 368/40
- Design Pressure (psig): 15
- Location: incell

ISSUED BY
RPP-WTP PDC

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

Operating Modes Considered:

- The breakpot is normally empty and at ambient temperature. Steam temperatures during transfers will be of short duration.
- Vessel may see acid during vessel washing or during inadvertent transfers.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.016 inch general allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for water and acid.

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This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
2	11/15/05	Issued for Permitting Use			
1	3/10/05	Issued for Permitting Use	DLA	JRD	APR
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Corrosion Considerations:

Breakpot will routinely transfer the ultrafiltration feed vessel heel prior to ultrafilter cleaning.

a General Corrosion
Hamner (1981) lists a corrosion rate for 304 (and 304L) in NaOH of less than 20 mpy (500 μm/y) at 77°F and over 20 mpy at 122°F. He shows 316 (and 316L) has a rate of less than 2 mpy up to 122°F and 50% NaOH. Dillon (2000) and Sedriks (1996) both state that the 300 series are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above. Divine's work (1986) with simulated-radwaste evaporators, six months at 140°F, showed 304L was slightly more resistant to corrosion (<0.2 mpy) than was 316L (<0.6 mpy); Ni 200, pure nickel, was much less resistant (≈7 mpy) probably due to the complexants. Zapp (1998) notes that the Savannah River evaporator vessels, operating at about 300°F, are made of 304L and have suffered no failures in about 30 years; 304L heat transfer surfaces have failed however after about 10 years.

Davis (1994) states the corrosion rate for 304L in pure NaOH will be less than about 0.1 mpy up to about 212°F though Sedriks (1996) states the data beyond about 122°F are incorrect. Danielson & Pitman (2000), based on short term studies, suggest a corrosion rate of about 0.5 mpy for 316L in simulated waste at boiling, >212°F.

Conclusion:
At temperatures less than about 140°F, 304L is expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy. Based on the Savannah River experience with Hanford-like waste at higher temperatures, 304L is expected to be satisfactory to 300°F.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Dillon (2000) is of the opinion that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices. Dillon and Koch (1995) are both of the opinion that fluoride will have little effect in an alkaline media. Jenkins (1998) has stated that localized corrosion can occur under the deposits on heat transfer surfaces, probably due to the chlorides. Further, Revie (2000) and Uhlig (1948) note nitrate inhibits chloride pitting. Normally the vessel is to operate at 77°F. At the normal temperature, based on the work of Zapp (1989) and others, 304L stainless steel would be acceptable in the proposed alkaline conditions. If acid washes are anticipated, care should be taken to minimize the presence of deposits. 316L will provide greater protection against pitting.

Conclusion:
Based on the expected operating conditions, 304L is expected to be satisfactory. However, due to the possible presence of acid and high halide concentrations, 316L is recommended.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not likely in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to stress corrosion crack stainless steel is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as a few ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F. Further, the use of "L" grade stainless reduces the opportunity for sensitization. Further, the presence of nitrate is expected to increase the limits slightly.

Conclusion:
For the normal operating conditions, the minimum alloy recommended is a 304L stainless steel.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Not expected to be a concern.

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g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth – the temperature is approximately correct but the pH under normal operating conditions is too alkaline. Further, the system is sufficiently far downstream of the main entry points of microbes that infection is unlikely.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a problem.

Conclusions
Not expected to be a concern.

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be contacted with particles of waste from splashing. A rinsing/flushing procedure will need to be developed to minimize the formation of deposits.

Conclusion:
Vapor phase corrosion is not a concern.

j Erosion
Velocities within the vessel are expected to be small. Based on 24590-WTP-RPT-M-04-0008, a general erosion allowance of 0.016 inch is adequate for components with solids content less than 27.3 wt%.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No opportunity for fretting exists.

Conclusion:
Not considered a problem.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not applicable.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid for a limited period.

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References:

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3. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
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24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Ultrafiltration recycle breakpot (UFP-BRKPT-00001A/B)

Facility PTF

In Black Cell? Yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine (Note 3)		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	3.61E+01	4.79E+01	3.61E+01	4.79E+01	
Chloride	g/l	1.20E+01	1.44E+01	1.20E+01	1.44E+01	
Fluoride	g/l	1.43E+01	1.72E+01	1.43E+01	1.72E+01	
Iron	g/l	1.69E+02	1.15E+02	1.69E+02	1.15E+02	
Nitrate	g/l	2.29E+02	2.63E+02	2.29E+02	2.63E+02	
Nitrite	g/l	6.66E+01	7.97E+01	6.66E+01	7.97E+01	
Phosphate	g/l	4.81E+01	5.63E+01	4.81E+01	5.63E+01	
Sulfate	g/l	2.56E+01	3.06E+01	2.56E+01	3.06E+01	
Mercury	g/l	1.18E+00	1.67E+00	1.18E+00	1.67E+00	
Carbonate	g/l	1.05E+02	1.06E+02	1.05E+02	1.06E+02	
Undissolved solids	wt%	25.00%	25.00%	25.00%	25.00%	
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					
Temperature	°F					
						Note 2
						Note 4

List of Organic Species:

References

System Description: 24590-PTF-3YD-UFP-00001, Rev 0
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: UFP38
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: 24590-PTF-M6-UFP-P0001, Rev 1
PFD: 24590-PTF-M5-V17T-P0009, Rev 0
Technical Reports :

Notes:

1. Concentrations less than 1×10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Steam is used for transfer. The breakpot is normally empty and at ambient temperature most of the time.
3. Same concentration during ultrafilter plugging as during normal cleaning operation.
4. Breakpot is used as radiation barrier and normally does not contain process fluid.

Assumptions:

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4.14.1 Ultrafiltration Recycle Breakpot (UFP-BRKPT-00001 A/B)

Routine Operations

Emptying the ultrafiltration feed vessel heel prior to ultrafilter cleaning.

Non-Routine Operations that Could Affect Corrosion/Erosion

Emptying the ultrafiltration feed vessel due to plugging of ultrafilters.